U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-260 011

# ANALYSIS OF FP AIR TRACER MATERIALS

METRONICS ASSOCIATES, INCORPORATED
PALO ALTO, CALIFORNIA

PREPARED FOR
ROBERT A. TAFT SANITARY ENGINEERING
CENTER, CINCINNATI, OHIO

26 AUGUST 1965

M 253017

PB 260 011

# MEMORANDUM REPORT NO. 233-1

# ANALYSIS OF FP AIR TRACER MATERIALS

**Prepared for:**

**Meteorology Section, Division of Air Pollution**
**Robert A. Taft Sanitary Engineering Center**
**Cincinnati, Ohio**

**Pursuant to:**

**United States Public Health Service**
**Department of Health, Education, and Welfare**
**P. O. No. 11420**

**26 August 1965**

METRONICS

## AEROSOL LABORATORY

METRONICS ASSOCIATES, INC.
STANFORD INDUSTRIAL PARK
PALO ALTO, CALIFORNIA

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

| BIBLIOGRAPHIC DATA SHEET | 1. Report No. | 2. | 3. Recipient's Accession No. PB-260 011 |
|---|---|---|---|
| 4. Title and Subtitle Analysis of FP Air Tracer Materials | | | 5. Report Date 26 Aug 65 |
| | | | 6. |
| 7. Author(s) T. S. Brown, J. A. Murray, and F. X. Webster | | | 8. Performing Organization Rept. No. MR-2331-1 and R233-1-174 |
| 9. Performing Organization Name and Address Metronics Associates, Inc., Palo Alto, California Aerosol Lab.* | | | 10. Project/Task/Work Unit No. |
| | | | 11. Contract/Grant No. |
| 12. Sponsoring Organization Name and Address *Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Meterology Section. *Public Health Service, Washington, D. C. | | | 13. Type of Report & Period Covered Memorandum |
| | | | 14. |

15. Supplementary Notes
Sponsored in part by Public Health Service, Washington, D. C.

16. Abstracts Specimens of candidate fluorescent particles from each of six lots manufactured by United States Radium Corporation for the U.S. Public Health Service Division of Air Pollution were submitted for physical analysis to determine for each lot specimen (1) characteristic particles-per-gram and mass-mean-diameter, (2) particle size distribution in approximately one-micron diameter intervals, and (3) certain additional qualitative characteristics pertinent to the suitability of these materials as FP air tracers. Results are included in tabular form.

17. Key Words and Document Analysis. 17a. Descriptors

17b. Identifiers/Open-Ended Terms

*Air pollution
*Particulates
Tables(Data)
*Tracer studies
Tracer techniques
*Trace elements
Aeronomy
Fluorescent particles

17c. COSATI Field/Group 13B

| 18. Availability Statement | 19. Security Class (This Report) UNCLASSIFIED | 21. No. of Pages 44p |
|---|---|---|
| | 20. Security Class (This Page UNCLASSIFIED | 22. Price |

MEMORANDUM REPORT NO. 233-1

26 August 1965

# ANALYSIS OF FP AIR TRACER MATERIALS

T. S. Brown
J. A. Murray
F. X. Webster

Prepared for:
Meteorology Section, Division of Air Pollution
Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

Pursuant to:
United States Public Health Service
Department of Health, Education, and Welfare
P.O. No. 11420

Aerosol Laboratory
Metronics Associates, Inc.
3201 Porter Drive
Palo Alto, California

LIST OF TABLES


| Table | | |
|---|---|---|
| A | Summary of FP Tracer Quality Control Analyses for Six Lots of USRC Fluorescent Material FP 2267 | |
| 1 | USRC Lot H-454: | MLS 192 Summary of Analyses |
| 2 | " " " | " " Particles-per-Gram Analysis |
| 3 | " " " | " " Particle Size Distribution Analysis: AT 134A |
| 4 | " " " | " " Particle Size Distribution Analysis: AT 134B |
| 5 | USRC Lot H-483: | MLS 270 Summary of Analyses |
| 6 | " " " | " " Particle-per-Gram Analysis |
| 7 | " " " | " " Summary of Particle Size Distribution Analyses |
| 8 | " " " | " " Particle Size Distribution Analysis: AT 155A |
| 9 | " " " | " " Particle Size Distribution Analysis: AT 155B |
| 10 | " " " | " " Particle Size Distribution Analysis: Special Duplicate of AT 155A |
| 11 | USRC Lot H-484: | MLS 271 Summary of Analyses |
| 12 | " " " | " " Particles-per-Gram Analysis |
| 13 | " " " | " " Summary of Particle Size Distribution Analyses |
| 14 | " " " | " " Particle Size Distribution Analysis: AT 163A |
| 15 | " " " | " " Particle Size Distribution Analysis: AT 163B |
| 16 | USRC Lot H-485: | MLS 272 Summary of Analyses |
| 17 | " " " | " " Particles-per-Gram Analysis |
| 18 | " " " | " " Summary of Particle Size Distribution Analyses |
| 19 | " " " | " " Particle Size Distribution Analysis: AT 165A |
| 20 | " " " | " " Particle Size Distribution Analysis: AT 165B |
| 21 | USRC Lot H-486: | MLS 273 Summary of Analyses |
| 22 | " " " | " " Particles-per-Gram Analysis |
| 23 | " " " | " " Summary of Particle Size Distribution Analyses |
| 24 | " " " | " " Particle Size Distribution Analysis: AT 166A |
| 25 | " " " | " " Particle Size Distribution Analysis: AT 166B |
| 26 | USRC Lot H-487: | MLS 274 Summary of Analyses |
| 27 | " " " | " " Particles-per-Gram Analysis |
| 28 | " " " | " " Summary of Particle Size Distribution Analyses |
| 29 | " " " | " " Particle Size Distribution Analysis: AT 167A |
| 30 | " " " | " " Particle Size Distribution Analysis: AT 167B |
| 31 | USRC Lot 454: | MLS 275 Log of Tracerite Shipped 25 Feb. 1965 |
| 32 | USRC Lot 483-487: | MLS 295: 296: 299: 300: 301: 302: 303: 304: 305: Log of Tracerite Shipped July 1965 |

MEMORANDUM REPO[illegible] NO. 233-1

Prepared for Meteorology Section, Division of Air Pollution,
U.S. Public Health Service, Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio, pursuant to DHEW-PHS P.O. No. 11420

## ANALYSIS OF FP AIR TRACER MATERIALS

PURPOSE: Specimens of candidate fluorescent particles from each of six (6) lots manufactured by United States Radium Corporation for U.S. Public Health Service Division of Air Pollution were submitted for physical analysis to determine for each lot specimen (a) characteristic particles-per-gram (PPG) and mass-mean-diameter (MMD), (b) particle size distribution in approximately one-micron diameter intervals, including the specification size ranges $<3/4\mu$, 3/4 - 5.5$\mu$, and $>5.5\mu$, and (c) certain additional qualitative characteristics pertinent to the suitability of these materials as FP air tracers. Approximately one-pound specimens of each of the lots listed in Table A were furnished for such analysis.

Services performed under this contract also included fluidization and packaging of each lot of tracer material as described below.

RESULTS: Given in Table A is an abbreviated summary of results for each of the six (6) lots tested. More complete tabular summaries and the detailed results from particles-per-gram and particle size analyses are given for each lot as shown in the List of Tables. Note that the analytical results for each lot are given in a consecutive series from four (4) to six (6) tables per lot.

For example for the second lot tested, Lot H-483, Table 5 summarizes all of the particle-size parameters and qualitative properties determined for that lot. Table 6 gives detailed results of aerosolization testing of this lot in terms of its characteristic particles-per-gram (PPG). These data show the ultimate number of PPG that can be made airborne when this lot of FP tracer is efficiently disseminated. Next, Table 7 summarizes, by micron intervals, the particle size distribution of FP collected on representative MF's from each of the duplicate run aerosolization tests. Finally Tables 8 and 9 give individual particle size distribution analyses for each MF examined. As an alternate procedure for some of the lots tested there are given results of duplicate size analyses by two different analysts, as shown in Table 10.

As each lot specimen was received for testing and analytical data obtained, three (3) copies of the tabular results were transmitted to Chief, Meteorology Section, Division of Air Pollution for his acceptance and/or comment. These results are also given here, together in one place as a final report on the analytical and fluidization services performed and as a convenient reference in connection with the evaluation of

sampling data from tests in which these tracer materials may be used.

Upon acceptance of each lot specimen, the entire lot quantitiy was fluidized by intimate blending with 1/2% by weight of a hydrophobic silica additive. The free-flowing dry powder was then poured into plastic squeeze bottles and accurately weighed and labeled to show net amount and lot numbers of contents. A log tally of individual container weights and lot numbers is also given in Tables 31 and 32.

The use of pre-weighed containers of fluidized FP tracer ensures improved aerosolization efficiency and ease of field filling of aerosol generator equipment. A photograph showing the equipment and procedure for transferring fluidized FP from a plastic shipping bottle into aerosol generator hopper is given on the last page of this report.

NOTES AND REFERENCES:

1. In all particle size analyses and FP tracer quality analyses the distributions and/or frequencies are given in percent by number. In most instances the actual total number of individual particles sized or otherwise examined is also given in each tabulation.

2. Aerosolization tests for the determination of PPG (particles-per-gram) and MMD (mass-mean diameter) were made with a high-speed centrifugal blower of the same power rating and modified configuration as the type blower used in the Models 3, 4, and 5 FP Tracer Aerosol Generator. Descriptions of the experimental procedures and computational models involved in this type of testing are given in the FP Tracer Manual (1955 Edition*) on pages 21-26 and 97-99. Recent improvements in aerosolization test procedures and calculations that were used for obtaining the data reported herein are given in Metronics Monthly Progress Report No. 21(R)-21, 30 November 1964.**

3. Particle size analyses were made at magnification of 210X using incident UV illumination. Equipment consisted of a continuously variable optical comparator microscope with automatic readout circuitry for tallying the number of particles in each micron size interval. A description of the sizing method used is given in Metronics Monthly Progress Report No. 21(R)-14, 30 April 1964.**

4. Particle counts for the determination of statistical estimates of total FP populations on membrane filters were made using the procedures given in Metronics Technical Manual 163-2, "FP Tracer Counting Manual".***

5. A resumé of fluidization methods and procedures are given in Metronics Monthly Progress Report No. 21(R)-19, September 1964.**

---

*"The Fluorescent Particle Tracer Technique: An Operational Manual," Department of Chemistry, Stanford University, June 1955.

**U.S. Army Dugway Proving Ground Contract DA-42-007-AMC-21(R).

***U.S. Weather Bureau Contract No. Cwb-10625.

Table A

SUMMARY OF FP TRACER QUALITY CONTROL ANALYSES FOR SIX (6) LOTS OF USRC FLUORESCENT MATERIAL

| | | | | | | |
|---|---|---|---|---|---|---|
| **Material Analyzed:** | | | | | | |
| Type | 2267 | 2267 | 2267 | 2267 | 2267 | 2267 |
| Fluorescent Color | Yellow | Yellow | Yellow | Yellow | Yellow | Yellow |
| USRC* Lot No. | H-454 | H-483 | H-484 | H-485 | H-486 | H-487 |
| Metronics Lot Specimen No. | #192 | #270 | #271 | #272 | #273 | #274 |
| **Aerosolization Analysis:** | | | | | | |
| Test Nos. | 134A & 134B | 155A & 155B | 163A & 163B | 165A & 165B | 166A & 166B | 167A & 167B |
| Mass Mean Diameter (MMD) | 2.86μ | 3.19μ | 2.88μ | 2.99μ | 3.17μ | 3.17μ |
| Particles per Gram (PPG) | $2.04 \times 10^{10}$ | $1.47 \times 10^{10}$ | $1.99 \times 10^{10}$ | $1.78 \times 10^{10}$ | $1.50 \times 10^{10}$ | $1.51 \times 10^{10}$ |
| **Particle Size Analysis:** | | | | | | |
| Specification Size Ranges: | | | | | | |
| <3/4 microns | 8.75% | 7.09% | 4.94% | 5.86% | 2.77% | 3.77% |
| 3/4 - 5.5 microns | 86.58% | 85.51% | 90.42% | 89.49% | 90.97% | 88.56% |
| > 5.5 microns | 4.67% | 7.40% | 4.65% | 4.67% | 6.25% | 7.67% |
| Number of Particles Sized | 2058 | 2650 | 2044 | 2118 | 2094 | 2150 |
| **FP Quality Analysis:** | | | | | | |
| Off-Color Particles | 2.81% | 3.05% | 4.71% | 1.23% | 4.16% | 3.21% |
| Non-Fluorescent Particles | 6.18% | 1.97% | 2.54% | 0.86% | 4.67% | 5.25% |
| Number Particles Examined for Color and Fluorescence | 2346 | 4885 | 2444 | 2435 | 4543 | 2108 |

*United States Radium Corporation, Whippany, New Jersey.

Table 1

SUMMARY OF FP TRACER MATERIAL QUALITY CONTROL ANALYSIS

FP 2267 - USRC Lot #H-454 MLS #192

Material Analyzed:

| | |
|---|---|
| Type | 2267 |
| Fluorescent Color | Yellow |
| USRC Lot No. | H-454 |
| Metronics Lot Specimen No. | #192 |
| Date Received for Analysis | 26 August 1964 |

Aerosolization Analysis:

| | |
|---|---|
| Test Nos. | 134A & 134B |
| Mass Mean Diameter (MMD) | 2.86 microns |
| Particles Per Gram (PPG) | $2.04 \times 10^{10}$ |

Particle Size Analysis:

| IK-MF No. | 134A:1-52&2-56 | 134B:1-57&2-55 | Average |
|---|---|---|---|
| Specification Size Ranges: | | | |
| < 3/4 microns | 8.15% | 9.34% | 8.75% |
| 3/4 - 5.5 microns | 85.87% | 87.30% | 86.58% |
| > 5.5 microns | 5.98% | 3.37% | 4.67% |
| Number of Particles Sized | 1019 | 1039 | 2058 |

FP Quality Analysis:

| IK-MF No. | 134A:1-52-11 | 134B:1-57-35 | Average |
|---|---|---|---|
| Off-Color Particles | 2.65% | 2.97% | 2.81% |
| Non-Fluorescent Particles | 4.89% | 7.46% | 6.18% |
| Number Particles Examined For Color and Fluorescence | 1166 | 1180 | 2346 |

Table 2

PARTICLES-PER-GRAM ANALYSIS OF FP MATERIAL FOR AIR TRACER STUDY

METRONICS LOT SPECIMEN NO. 192

Analysis made for: U.S. Public Health Service, pursuant to Purchase Order #11420, 25 June 1964.

Material tested: FP 2267, USRC Lot H-454. Tests performed on 1-lb specimen received 26 August 1964 via USRC Shipping Memorandum No. NJ-W 13424, Customer Order No. 11382, USPHS.

| Aerosolization Test No. | Isokinetic Sampler No. | Aerosolization Factor Particles Per Gram |
|---|---|---|
| 134A | 1-52-11 | $2.093 \times 10^{10}$ |
| | 2-56-21 | 2.168 |
| | 3-65-29 | 1.989 |
| | Test 134A Average | $2.083 \times 10^{10}$ |
| 134B | 1-57-35 | $2.107 \times 10^{10}$ |
| | 2-55-24 | 1.814 |
| | 3-66-34 | 2.088 |
| | Test 134B Average | $2.003 \times 10^{10}$ |

Analysis Summary - Combined Data Tests 134A & 134B

| | |
|---|---|
| Aerosolization PPG - Mean Value | $2.043 \times 10^{10}$ |
| Aerosolization PPG - Coefficient of Variation | $\pm$ 5.63% |
| Equivalent Mass Mean Particle Diameter | 2.86 microns |

Table 3

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot #H-454

Metronics Lot Specimen (MLS) #192 - 26 August 1964

MF's from Aerosolization Test No. 134 - Trial A

| Particle Size Range Micron Diam. | IK-MF Number MF 1-52 % | MF 2-56 % | Combined Data Both MF's % |
|---|---|---|---|
| < 0.75 | 6.50 | 9.78 | 8.15 |
| 0.75 - 1.5 | 12.60 | 15.85 | 14.23 |
| 1.5 - 2.6 | 25.98 | 24.85 | 25.42 |
| 2.6 - 3.5 | 22.44 | 25.44 | 23.94 |
| 3.5 - 4.5 | 16.34 | 13.11 | 14.72 |
| 4.5 - 5.5 | 7.68 | 7.44 | 7.56 |
| 5.5 - 6.6 | 5.91 | 2.15 | 4.02 |
| 6.6 - 7.5 | 1.57 | .39 | .98 |
| 7.5 - 8.5 | .59 | .39 | .49 |
| 8.5 - 10.0 | .39 | .59 | .49 |
| | | | 100.00% |
| Number of Individual Particles Sized | 508 | 511 | 1019 |

Specification Size Range Distribution

| | | | |
|---|---|---|---|
| < 0.75 | 6.50% | 9.78% | 8.15% |
| 0.75 - 5.5 | 85.04% | 86.69% | 85.87% |
| > 5.5 | 8.46% | 3.52% | 5.98% |

Table 4

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot #H-454

Metronics Lot Specimen (MLS) #192 - 26 August 1964

MF's from Aerosolization Test No. 134 - Trial B

| Particle Size Range Micron Diam. | IK-MF Number MF 1-57 % | MF 2-55 % | Combined Data Both MF's % |
|---|---|---|---|
| < 0.75 | 9.50 | 9.18 | 9.34 |
| 0.75 - 1.5 | 15.70 | 14.15 | 14.92 |
| 1.5 - 2.6 | 25.78 | 26.00 | 25.89 |
| 2.6 - 3.5 | 25.39 | 23.90 | 24.64 |
| 3.5 - 4.5 | 14.15 | 15.68 | 14.92 |
| 4.5 - 5.5 | 5.62 | 8.22 | 6.93 |
| 5.5 - 6.6 | 3.69 | 1.91 | 2.79 |
| 6.6 - 7.5 | 0.19 | .57 | .38 |
| 20.0 - 22.0 | | .19 | 0.10 |
| 22.0 - 24.0 | | --- | --- |
| 24.0 - 30.0 | | .19 | 0.10 |
| | | | 100.01% |
| Number of Individual Particles Sized | 516 | 523 | 1039 |
| | Specification Size Range Distribution | | |
| < 0.75 | 9.50% | 9.18% | 9.34% |
| 0.75 - 5.5 | 86.64% | 87.94% | 87.30% |
| > 5.5 | 3.88% | 2.86% | 3.37% |

METRONICS

Table 5

SUMMARY OF FP TRACER MATERIAL QUALITY CONTROL ANALYSES:

FP 2267 - USRC Lot #H-483 MLS #270

| | | | |
|---|---|---|---|
| **Material Analyzed:** | | | |
| Type | | 2267 | |
| Fluorescent Color | | Yellow | |
| Lot No. | | H-483 | |
| Metronics Lot Specimen No. | | #270 | |
| Date Received for Analysis | | 28 January 1965 | |
| **Aerosolization Analysis:** | | | |
| Test Nos. | | 155A & 155B | |
| Mass Mean Diameter (MMD) | | 3.19μ | |
| Particles Per Gram (PPG) | | $1.47 \times 10^{10}$ | |
| **Particle Size Analysis:** | | | |
| IK-MF No. | 155A: 1-61&2-62 | 155B: 1-66&2-67 | Average |
| Specification Size Ranges: | | | |
| < 3/4 microns | 6.30% | 8.29% | 7.09% |
| 3/4 - 5.5 microns | 86.40% | 84.18% | 85.51% |
| > 5.5 microns | 7.30% | 7.53% | 7.40% |
| Number of Particles Sized | 1588 | 1062 | 2650 |
| **FP Quality Analysis:** | | | |
| IK-MF No. | 155A: 1-61 | 155B: 1-66 | Average |
| Off-Color Particles | 3.81% | 2.31% | 3.05% |
| Non-Fluorescent Particles | 2.24% | 1.70% | 1.97% |
| Number Particles Examined for Color and Fluorescence | 2416 | 2469 | 4885 |
| Bulk Powder Fluidity | | | OK |

Table 6

PARTICLES-PER-GRAM ANALYSIS OF FP MATERIAL FOR AIR TRACER STUDY

METRONICS LOT SPECIMEN NO. 270

Analysis made for: U.S. Public Health Service, pursuant to Purchase Order #11420, 25 June 1964.

Material tested: FP 2267-Yellow, USRC Lot #H-483. Tests performed on 1-lb specimen received 28 January 1965 via USRC Shipping Memorandum No. NJ-W 521.

| Aerosolization Test No. | Isokinetic Sampler No. | Aerosolization Factor Particles Per Gram |
|---|---|---|
| 155A | 1-61-15 | $1.401 \times 10^{10}$ |
| | 2-62-16 | 1.771 |
| | 3-63-18 | 1.149 |
| | 4-65-19 | 1.505 |
| | Test 155A Average | $1.456 \times 10^{10}$ |
| 155B | 1-66-20 | $1.639 \times 10^{10}$ |
| | 2-67-21 | 1.673 |
| | 3-68-22 | 1.256 |
| | 4-69-23 | 1.383 |
| | Test 155B Average | $1.488 \times 10^{10}$ |

Analysis Summary - Combined Data Tests 155A & 155B

| | |
|---|---|
| Aerosolization PPG - Mean Value | $1.472 \times 10^{10}$ |
| Aerosolization PPG - Coefficient of Variation | $\pm$ 13.6% |
| Equivalent Mass Mean Particle Diameter | 3.19 microns |

Table 7

SUMMARY OF FP TRACER PARTICLE SIZE DISTRIBUTION ANALYSES

Material: FP 2267 - USRC Lot H-483 - MLS #270

Aerosolization Test Results (155A & 155B): PPG $1.47 \times 10^{10}$; MMD 3.19μ

| Particle Size Range Micron Dia | Combined Analysis FP's Collected on 2 MF's from Test 155A % | Combined Analysis FP's Collected on 2 MF's from Test 155B % | Combined Analysis All 4 MF's % |
|---|---|---|---|
| < 0.75 | 6.30 | 8.29 | 7.09 |
| 0.75 - 1.5 | 16.44 | 16.38 | 16.42 |
| 1.5 - 2.6 | 21.85 | 22.69 | 22.19 |
| 2.6 - 3.5 | 22.10 | 22.03 | 22.08 |
| 3.5 - 4.5 | 17.25 | 16.29 | 16.87 |
| 4.5 - 5.5 | 8.75 | 6.78 | 7.96 |
| 5.5 - 6.6 | 4.85 | 4.43 | 4.68 |
| 6.6 - 7.5 | 1.45 | 1.51 | 1.47 |
| 7.5 - 8.5 | 0.44 | 1.22 | 0.75 |
| 8.5 - 10.0 | 0.50 | 0.19 | 0.38 |
| 10 - 12 | 0.06 | 0.19 | 0.11 |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| Number of Individual Particles Sized | 1588 | 1062 | 2650 |
| | Specification Size Range Distribution | | |
| < 0.75 | 6.30% | 8.29% | 7.09% |
| 0.75 - 5.5 | 86.39% | 84.17% | 85.52% |
| > 5.5 | 7.30% | 7.54% | 7.39% |

Table 8

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-483

Metronics Lot Specimen (MLS) 270

MF's from Aerosolization Test No. 155 - Trial A

| Particle Size Range Micron Dia | IK-MF Number MF 1-61-15* % | MF 2-62-16 % | Combined Data Both MF's % |
|---|---|---|---|
| < 0.75 | 6.48 | 5.94 | 6.30 |
| 0.75 - 1.5 | 18.21 | 12.99 | 16.44 |
| 1.5 - 2.6 | 21.45 | 22.63 | 21.85 |
| 2.6 - 3.5 | 20.97 | 24.30 | 22.10 |
| 3.5 - 4.5 | 17.06 | 17.63 | 17.25 |
| 4.5 - 5.5 | 8.39 | 9.46 | 8.75 |
| 5.5 - 6.6 | 4.29 | 5.94 | 4.85 |
| 6.6 - 7.5 | 2.00 | 0.37 | 1.45 |
| 7.5 - 8.5 | 0.48 | 0.37 | 0.44 |
| 8.5 - 10.0 | 0.57 | 0.37 | 0.50 |
| 10 - 12 | 0.10 | --- | 0.06 |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| | | | 99.99% |
| Number of Individual Particles Sized | 1049 | 539 | 1588 |
| | Specification Size Range Distribution | | |
| < 0.75 | 6.48% | 5.94% | 6.30% |
| 0.75 - 5.5 | 86.08% | 87.01% | 86.39% |
| > 5.5 | 7.44% | 7.05% | 7.30% |

*Duplicate analysis made on this MF; see Table 10 for results of individual analyses.

Table 9

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-483

Metronics Lot Specimen (MLS) 270

MF's from Aerosolization Test No. 155 - Trial B

| Particle Size Range Micron Dia | IK-MF Number MF 1-66-20 % | MF 2-67-21 % | Combined Data Both MF's % |
|---|---|---|---|
| < 0.75 | 12.24 | 4.21 | 8.29 |
| 0.75 - 1.5 | 14.84 | 17.97 | 16.38 |
| 1.5 - 2.6 | 20.78 | 24.67 | 22.69 |
| 2.6 - 3.5 | 22.63 | 21.41 | 22.03 |
| 3.5 - 4.5 | 16.33 | 16.25 | 16.29 |
| 4.5 - 5.5 | 6.68 | 6.88 | 6.78 |
| 5.5 - 6.6 | 3.90 | 4.97 | 4.43 |
| 6.6 - 7.5 | 1.86 | 1.15 | 1.51 |
| 7.5 - 8.5 | 0.74 | 1.72 | 1.22 |
| 8.5 - 10.0 | --- | 0.38 | 0.19 |
| 10 - 12 | --- | 0.38 | 0.19 |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| | | | 100.00% |
| Number of Individual Particles Sized | 539 | 523 | 1062 |
| | Specification Size Range Distribution | | |
| < 0.75 | 12.24% | 4.21% | 8.29% |
| 0.75 - 5.5 | 81.26% | 87.18% | 84.17% |
| > 5.5 | 6.50% | 8.60% | 7.54% |

Table 10

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-483-MLS #270

Special Duplicate Analysis of FP's Collected on MF #1-61-15

from Aerosolization Test No. 155A

| Particle Size Range Micron Dia | 1st Analysis (MPP) % | 2nd Analysis (JGC) % | Combined % |
|---|---|---|---|
| < 0.75 | 7.10 | 5.84 | 6.48 |
| 0.75 - 1.5 | 16.82 | 19.65 | 18.21 |
| 1.5 - 2.6 | 21.50 | 21.40 | 21.45 |
| 2.6 - 3.5 | 23.18 | 18.68 | 20.97 |
| 3.5 - 4.5 | 15.14 | 19.07 | 17.06 |
| 4.5 - 5.5 | 6.36 | 10.51 | 8.39 |
| 5.5 - 6.6 | 5.23 | 3.31 | 4.29 |
| 6.6 - 7.5 | 2.99 | 0.97 | 2.00 |
| 7.5 - 8.5 | 0.37 | 0.58 | 0.48 |
| 8.5 - 10.0 | 1.12 | --- | 0.57 |
| 10 - 12 | 0.19 | --- | 0.10 |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| | | | 100.00% |
| Number of Individual Particles Sized | 535 | 514 | 1049 |

Specification Size Range Distribution

| | | | |
|---|---|---|---|
| < 0.75 | 7.10% | 5.84% | 6.48% |
| 0.75 - 5.5 | 82.99% | 89.31% | 86.08% |
| > 5.5 | 9.91% | 4.86% | 7.44% |

METRONICS

Table 11

## SUMMARY OF FP TRACER MATERIAL QUALITY CONTROL ANALYSES

## FP 2267 - USRC Lot -H-484 -MLS #271

| | | | |
|---|---|---|---|
| **Material Analyzed:** | | | |
| Type | | 2267 | |
| Fluorescent Color | | Yellow | |
| USRC Lot No. | | H-484 | |
| Metronics Lot Specimen No. | | 271 | |
| Date Received for Analysis | | 28 January 1965 | |
| **Aerosolization Analysis:** | | | |
| Test Nos. | | 163A & 163B | |
| Mass Mean Diameter (MMD) | | 2.88 microns | |
| Particles Per Gram (PPG) | | $1.99 \times 10^{10}$ | |
| **Particle Size Analysis:** | | | |
| IK-MF No. | 163A: 1-58 | 163B: 1-63 | Average |
| Specification Size Ranges: | | | |
| < 3/4 microns | 4.51% | 5.37% | 4.94% |
| 3/4 - 5.5 microns | 90.68% | 90.15% | 90.42% |
| > 5.5 microns | 4.81% | 4.49% | 4.65% |
| Number of Particles Sized | 1019 | 1025 | 2044 |
| **FP Quality Analysis:** | | | |
| IK-MF No. | 163A: 1-58 | 163B: 1-63 | Average |
| Off-Color Particles | 4.72% | 4.69% | 4.71% |
| Non-Fluorescent Particles | 2.68% | 2.39% | 2.54% |
| Number Particles Examined for Color and Fluorescence | 1271 | 1173 | 2444 |
| Bulk Powder Fluidity | | | OK |

Table 12

PARTICLES-PER-GRAM ANALYSIS OF FP MATERIAL FOR AIR TRACER STUDY

METRONICS LOT SPECIMEN NO. 271

Analysis made for: U.S. Public Health Service, pursuant to Purchase Order #11420, 25 June 1964.

Material tested: FP 2267-Yellow, USRC Lot #H-484. Tests performed on 1-lb specimen received 28 January 1965 via USRC Shipping Memorandum No. NJ-W 521.

| Aerosolization Test No. | Isokinetic Sampler No. | Aerosolization Factor Particles Per Gram |
|---|---|---|
| 163A | 1-58-21 | $2.184 \times 10^{10}$ |
| | 2-60-22 | 1.998 |
| | 3-59-23 | 1.911 |
| | 4-68-24 | 2.125 |
| | Test 163A Average | $2.054 \times 10^{10}$ |
| 163B | 1-63-25 | $1.968 \times 10^{10}$ |
| | 2-62-26 | 2.315 |
| | 3-54-34 | 1.680 |
| | 4-55-20 | 1.747 |
| | Test 163B Average | $1.928 \times 10^{10}$ |

Analysis Summary - Combined Data Tests 163A & 163B

| | |
|---|---|
| Aerosolization PPG - Mean Value | $1.99 \times 10^{10}$ |
| Aerosolization PPG - Coefficient of Variation | $\pm$ 10.1% |
| Equivalent Mass Mean Particle Diameter | 2.88 microns |

Table 13

SUMMARY OF FP TRACER PARTICLE SIZE DISTRIBUTION ANALYSES

Material: FP 2267 - USRC Lot H-484 - MLS #271

Aerosolization Test Results (163A & 163B): PPG $1.99 \times 10^{10}$; MMD 2.88μ

| Particle Size Range Micron Dia | Combined Analysis FP's Collected on MF from Test 163A % | Combined Analysis FP's Collected on MF from Test 163B % | Combined Analysis Both MF's % |
|---|---|---|---|
| < 0.75 | 4.51 | 5.37 | 4.94 |
| 0.75 - 1.5 | 15.01 | 18.73 | 16.88 |
| 1.5 - 2.6 | 29.15 | 29.27 | 29.21 |
| 2.6 - 3.5 | 24.53 | 22.34 | 23.44 |
| 3.5 - 4.5 | 13.84 | 13.27 | 13.55 |
| 4.5 - 5.5 | 8.15 | 6.54 | 7.34 |
| 5.5 - 6.6 | 3.24 | 2.83 | 3.03 |
| 6.6 - 7.5 | 0.98 | 0.78 | 0.88 |
| 7.5 - 8.5 | 0.10 | 0.39 | 0.25 |
| 8.5 - 10.0 | 0.49 | 0.49 | 0.49 |
| 10 - 12 | --- | --- | --- |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| 16 - 18 | --- | --- | --- |
| 18 - 20 | --- | --- | --- |
| Number of Individual Particles Sized | 1019 | 1025 | 2044 |
| | Specification Size Range Distribution | | |
| < 0.75 | 4.51% | 5.37% | 4.94% |
| 0.75 - 5.5 | 90.68% | 90.15% | 90.42% |
| > 5.5 | 4.81% | 4.49% | 4.65% |

Table 14

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-484-MLS #271

Duplicate Analysis of FP's Collected on MF #1-58-21
from Aerosolization Test No. 163A

| Particle Size Range Micron Dia | 1st Analysis (JGC) % | 2nd Analysis (MPP) % | Combined % |
|---|---|---|---|
| < 0.75 | 5.53 | 3.51 | 4.51 |
| 0.75 - 1.5 | 13.64 | 16.37 | 15.01 |
| 1.5 - 2.6 | 28.85 | 29.43 | 29.15 |
| 2.6 - 3.5 | 23.32 | 25.73 | 24.53 |
| 3.5 - 4.5 | 15.61 | 12.08 | 13.84 |
| 4.5 - 5.5 | 9.29 | 7.02 | 8.15 |
| 5.5 - 6.6 | 2.96 | 3.51 | 3.24 |
| 6.6 - 7.5 | 0.40 | 1.56 | 0.98 |
| 7.5 - 8.5 | 0.20 | ---- | 0.10 |
| 8.5 - 10.0 | 0.20 | 0.78 | 0.49 |
| 10 - 12 | ---- | ---- | ---- |
| 12 - 14 | ---- | ---- | ---- |
| 14 - 16 | ---- | ---- | ---- |
| | | | 100.00% |
| Number of Individual Particles Sized | 506 | 513 | 1019 |

Specification Size Range Distribution

| | | | |
|---|---|---|---|
| < 0.75 | 5.53% | 3.51% | 4.51% |
| 0.75 - 5.5 | 90.71% | 90.63% | 90.68% |
| > 5.5 | 3.76% | 5.85% | 4.81% |

Table 15

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-484-MLS #271

Duplicate Analysis of FP's Collected on MF #1-63-25
from Aerosolization Test No. 163B

| Particle Size Range Micron Dia | 1st Analysis (MPP) % | 2nd Analysis (JGC) % | Combined % |
|---|---|---|---|
| < 0.75 | 3.90 | 6.84 | 5.37 |
| 0.75 - 1.5 | 19.49 | 17.97 | 18.73 |
| 1.5 - 2.6 | 24.95 | 33.59 | 29.27 |
| 2.6 - 3.5 | 25.73 | 18.95 | 22.34 |
| 3.5 - 4.5 | 13.26 | 13.28 | 13.27 |
| 4.5 - 5.5 | 7.21 | 5.86 | 6.54 |
| 5.5 - 6.6 | 2.73 | 2.93 | 2.83 |
| 6.6 - 7.5 | 1.56 | ---- | 0.78 |
| 7.5 - 8.5 | 0.39 | 0.39 | 0.39 |
| 8.5 - 10.0 | 0.78 | 0.20 | 0.49 |
| 10 - 12 | ---- | ---- | ---- |
| 12 - 14 | ---- | ---- | ---- |
| 14 - 16 | ---- | ---- | ---- |
| | | | 100.01% |
| Number of Individual Particles Sized | 513 | 512 | 1025 |
| | Specification Size Range Distribution | | |
| < 0.75 | 3.90% | 6.84% | 5.37% |
| 0.75 - 5.5 | 90.64% | 89.65% | 90.15% |
| > 5.5 | 5.46% | 3.52% | 4.49% |

METRONICS

Table 16

SUMMARY OF FP TRACER MATERIAL QUALITY CONTROL ANALYSES:

FP 2267 - USRC Lot 485 MLS #272

| | | | |
|---|---|---|---|
| **Material Analyzed:** | | | |
| Type | | 2267 | |
| Fluorescent Color | | Yellow | |
| USRC Lot No. | | H-485 | |
| Metronics Lot Specimen No. | | #272 | |
| Date Received for Analysis | | 28 January 1965 | |
| **Aerosolization Analysis:** | | | |
| Test Nos. | | 165A & 165B | |
| Mass Mean Diameter (MMD) | | 2.99 microns | |
| Particles Per Gram (PPG) | | $1.78 \times 10^{10}$ | |
| **Particle Size Analysis:** | | | |
| IK-MF No. | 165A-1-70 | 165B-1-59 | Average |
| Specification Size Ranges: | | | |
| < 3/4 microns | 5.26% | 6.39% | 5.86% |
| 3/4 - 5.5 microns | 90.17% | 88.84% | 89.47% |
| > 5.5 microns | 4.57% | 4.77% | 4.67% |
| Number of Particles Sized | 1007 | 1111 | 2118 |
| **FP Quality Analysis:** | | | |
| IK-MF No. | 165A-1-70 | 165B-1-59 | Average |
| Off-Color Particles | 1.25% | 1.22% | 1.23% |
| Non-Fluorescent Particles | 1.25% | 0.53% | 0.86% |
| Number Particles Examined for Color and Fluorescence | 1120 | 1315 | 2435 |
| Bulk Powder Fluidity | | | OK |

Table 17

PARTICLES-PER-GRAM ANALYSIS OF FP MATERIAL FOR AIR TRACER STUDY

METRONICS LOT SPECIMEN NO. 272

Analysis made for: U.S. Public Health Service, pursuant to Purchase Order #11420, 25 June 1964.

Material tested: FP 2267-Yellow, USRC Lot #H-485. Tests performed on 1-lb specimen received 28 January 1965 via USRC Shipping Memorandum No. NJ-W 521.

| Aerosolization Test No. | Isokinetic Sampler No. | Aerosolization Factor Particles Per Gram |
|---|---|---|
| 165A | 1-70-20 | $2.038 \times 10^{10}$ |
| | 2-53-23 | 1.776 |
| | 3-72-27 | 1.348 |
| | 4-78-28 | 1.726 |
| | Test 165A Average | $1.722 \times 10^{10}$ |
| 165B | 1-59-29 | $2.031 \times 10^{10}$ |
| | 2-51-31 | 1.848 |
| | 3-52-32 | 1.754 |
| | 4-55-33 | 1.747 |
| | Test 165B Average | $1.845 \times 10^{10}$ |

Analysis Summary - Combined Data Tests 165A & 165B

| | |
|---|---|
| Aerosolization PPG - Mean Value | $1.78 \times 10^{10}$ |
| Aerosolization PPG - Coefficient of Variation | $\pm$ 11.3% |
| Equivalent Mass Mean Particle Diameter | 2.99 microns |

Table 18

SUMMARY OF FP TRACER PARTICLE SIZE DISTRIBUTION ANALYSES

Material: FP 2267 - USRC Lot H-485 - MLS #272

Aerosolization Test Results (165A & 165B): PPG $1.78 \times 10^{10}$; MMD 2.99μ

| Particle Size Range Micron Dia | Combined Analysis FP's Collected on MF from Test 165A % | Combined Analysis FP's Collected on MF from Test 165B % | Combined Analysis Both MF's % |
|---|---|---|---|
| < 0.75 | 5.26 | 6.39 | 5.86 |
| 0.75 - 1.5 | 15.99 | 16.92 | 16.48 |
| 1.5 - 2.6 | 30.39 | 27.63 | 28.94 |
| 2.6 - 3.5 | 22.34 | 21.60 | 21.95 |
| 3.5 - 4.5 | 14.20 | 14.58 | 14.40 |
| 4.5 - 5.5 | 7.25 | 8.10 | 7.70 |
| 5.5 - 6.6 | 3.38 | 2.43 | 2.88 |
| 6.6 - 7.5 | 0.50 | 1.44 | 0.99 |
| 7.5 - 8.5 | 0.30 | 0.45 | 0.38 |
| 8.5 - 10.0 | 0.20 | 0.27 | 0.24 |
| 10 - 12 | 0.10 | 0.09 | 0.09 |
| 12 - 14 | ---- | ---- | ---- |
| 14 - 16 | ---- | 0.09 | 0.05 |
| 16 - 18 | ---- | ---- | ---- |
| 18 - 20 | 0.10 | ---- | 0.05 |
| Number of Individual Particles Sized | 1007 | 1111 | 2118 |
| | Specification Size Range Distribution | | |
| < 0.75 | 5.26% | 6.39% | 5.86% |
| 0.75 - 5.5 | 90.17% | 88.84% | 89.47% |
| > 5.5 | 4.57% | 4.77% | 4.67% |

Table 19

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-485-MLS #272

Duplicate Analysis of FP's Collected on MF # 1-70-20
from Aerosolization Test No. 165A

| Particle Size Range Micron Dia | 1st Analysis (MPP) % | 2nd Analysis (JGC) % | Combined % |
|---|---|---|---|
| < 0.75 | 7.18 | 3.36 | 5.26 |
| 0.75 - 1.5 | 16.77 | 15.22 | 15.99 |
| 1.5 - 2.6 | 30.74 | 30.04 | 30.39 |
| 2.6 - 3.5 | 20.36 | 24.31 | 22.34 |
| 3.5 - 4.5 | 13.57 | 14.82 | 14.20 |
| 4.5 - 5.5 | 5.99 | 8.50 | 7.25 |
| 5.5 - 6.6 | 3.99 | 2.77 | 3.38 |
| 6.6 - 7.5 | 0.80 | 0.20 | 0.50 |
| 7.5 - 8.5 | 0.40 | 0.20 | 0.30 |
| 8.5 - 10.0 | ---- | 0.39 | 0.20 |
| 10 - 12 | ---- | 0.20 | 0.10 |
| 12 - 14 | ---- | ---- | ---- |
| 14 - 16 | ---- | ---- | ---- |
| 16 - 18 | ---- | ---- | ---- |
| 18 - 20 | 0.20 | ---- | 0.10 |
| | | | 100.10% |
| Number of Individual Particles Sized | 501 | 506 | 1007 |
| | Specification Size Range Distribution | | |
| < 0.75 | 7.18% | 3.36% | 5.26% |
| 0.75 - 5.5 | 87.43% | 92.89% | 90.17% |
| > 5.5 | 5.39% | 3.75% | 4.57% |

Table 20

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-485-MLS #272

Duplicate Analysis of FP's Collected on MF # 1-59-29

from Aerosolization Test No. 165B

| Particle Size Range Micron Dia | 1st Analysis (MPP) % | 2nd Analysis (JGC) % | Combined % |
|---|---|---|---|
| < 0.75 | 4.46 | 8.52 | 6.39 |
| 0.75 - 1.5 | 17.84 | 15.91 | 16.92 |
| 1.5 - 2.6 | 24.53 | 31.06 | 27.63 |
| 2.6 - 3.5 | 21.96 | 21.21 | 21.60 |
| 3.5 - 4.5 | 16.12 | 12.88 | 14.58 |
| 4.5 - 5.5 | 9.26 | 6.82 | 8.10 |
| 5.5 - 6.6 | 2.06 | 2.84 | 2.43 |
| 6.6 - 7.5 | 2.40 | 0.38 | 1.44 |
| 7.5 - 8.5 | 0.69 | 0.19 | 0.45 |
| 8.5 - 10.0 | 0.34 | 0.19 | 0.27 |
| 10 - 12 | 0.17 | ---- | 0.09 |
| 12 - 14 | ---- | ---- | ---- |
| 14 - 16 | 0.17 | ---- | 0.09 |
| 16 - 18 | ---- | ---- | ---- |
| 18 - 20 | ---- | ---- | ---- |
| | | | 99.99% |
| Number of Individual Particles Sized | 583 | 528 | 1111 |

Specification Size Range Distribution

| | | | |
|---|---|---|---|
| < 0.75 | 4.46% | 8.52% | 6.39% |
| 0.75 - 5.5 | 89.71% | 87.88% | 88.84% |
| > 5.5 | 5.83% | 3.60% | 4.77% |

METRONICS

Table 21

SUMMARY OF FP TRACER MATERIAL QUALITY CONTROL ANALYSES:

FP 2267 - USRC Lot 486 MLS #273

Material Analyzed:

| | |
|---|---|
| Type | 2267 |
| Fluorescent Color | Yellow |
| USRC Lot No. | H-486 |
| Metronics Lot Specimen No. | #273 |
| Date Received for Analysis | 28 January 1965 |

Aerosolization Analysis:

| | |
|---|---|
| Test Nos. | 166A & 166B |
| Mass Mean Diameter (MMD) | 3.17 microns |
| Particles Per Gram (PPG) | $1.50 \times 10^{10}$ |

Particle Size Analysis:

| IK-MF No. | 166A:1-66 | 166B:1-56 | Average |
|---|---|---|---|
| Specification Size Ranges: | | | |
| < 3/4 microns | 4.22% | 1.39% | 2.77% |
| 3/4 - 5.5 microns | 88.80% | 93.02% | 90.97% |
| > 5.5 microns | 6.97% | 5.57% | 6.25% |
| Number of Particles Sized | 1018 | 1076 | 2094 |

FP Quality Analysis:

| IK-MF No. | 166A1-66 | 166B:1-56 | Average |
|---|---|---|---|
| Off-Color Particles | 1.46% | 5.02% | 4.16% |
| Non-Fluorescent Particles | 2.55% | 5.34% | 4.67% |
| Number Particles Examined for Color and Fluorescence | 1097 | 3446 | 4543 |
| Bulk Powder Fluidity | | | OK |

Table 22

PARTICLES-PER-GRAM ANALYSIS OF FP MATERIAL FOR AIR TRACER STUDY

METRONICS LOT SPECIMEN NO. 273

Analysis made for: U.S. Public Health Service, pursuant to Purchase Order #11420, 25 June 1964.

Material tested: FP 2267-Yellow, USRC Lot #H-486. Tests performed on 1-lb specimen received 28 January 1965 via USRC Shipping Memorandum No. NJ-W 521.

| Aerosolization Test No. | Isokinetic Sampler No. | Aerosolization Factor Particles Per Gram |
|---|---|---|
| 166A | 1-66-10 | $1.784 \times 10^{10}$ |
| | 2-58-05 | 1.308 |
| | 3-77-18 | 1.558 |
| | 4-71-33 | 1.414 |
| | Test 166A Average | $1.516 \times 10^{10}$ |
| 166B | 1-56-29 | $1.506 \times 10^{10}$ |
| | 2-61-50 | 1.324 |
| | 3-62-28 | 1.639 |
| | 4-60-23 | 1.496 |
| | Test 166B Average | $1.491 \times 10^{10}$ |

Analysis Summary - Combined Data Tests 166A & 166B

| | |
|---|---|
| Aerosolization PPG - Mean Value | $1.50 \times 10^{10}$ |
| Aerosolization PPG - Coefficient of Variation | $\pm$ 9.9% |
| Equivalent Mass Mean Particle Diameter | 3.17 microns |

Table 23

SUMMARY OF FP TRACER PARTICLE SIZE DISTRIBUTION ANALYSES

Material: FP 2267 - USRC Lot H-486 - MLS #273

Aerosolization Test Results (166A & 166B): PPG $1.50 \times 10^{10}$; MMD 3.17μ

| Particle Size Range Micron Dia | Combined Analysis FP's Collected on MF from Test 166A % | Combined Analysis FP's Collected on MF from Test 166B % | Combined Analysis Both MF's % |
|---|---|---|---|
| < 0.75 | 4.22 | 1.39 | 2.77 |
| 0.75 - 1.5 | 10.41 | 11.52 | 10.98 |
| 1.5 - 2.6 | 28.19 | 29.55 | 28.89 |
| 2.6 - 3.5 | 24.85 | 28.81 | 26.89 |
| 3.5 - 4.5 | 15.91 | 14.96 | 15.42 |
| 4.5 - 5.5 | 9.43 | 8.18 | 8.79 |
| 5.5 - 6.6 | 4.52 | 3.62 | 4.06 |
| 6.6 - 7.5 | 1.38 | 1.02 | 1.19 |
| 7.5 - 8.5 | 0.88 | 0.84 | 0.86 |
| 8.5 - 10.0 | 0.20 | 0.09 | 0.14 |
| 10 - 12 | --- | --- | --- |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| 16 - 18 | --- | --- | --- |
| 18 - 20 | --- | --- | --- |
| | | | 99.99% |
| Number of Individual Particles Sized | 1018 | 1076 | 2094 |
| | Specification Size Range Distribution | | |
| < 0.75 | 4.22% | 1.39% | 2.77% |
| 0.75 - 5.5 | 88.80% | 93.02% | 90.97% |
| > 5.5 | 6.97% | 5.57% | 6.25% |

Table 24

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-486 - MLS #273

Duplicate Analysis of FP's Collected on MF #1-66-10

from Aerosolization Test No. 166A

| Particle Size Range Micron Dia | 1st Analysis (MPP) % | 2nd Analysis (JGC) % | Combined % |
|---|---|---|---|
| < 0.75 | 5.19 | 3.29 | 4.22 |
| 0.75 - 1.5 | 10.98 | 9.86 | 10.41 |
| 1.5 - 2.6 | 25.35 | 30.95 | 28.19 |
| 2.6 - 3.5 | 24.75 | 24.95 | 24.85 |
| 3.5 - 4.5 | 15.97 | 15.86 | 15.91 |
| 4.5 - 5.5 | 10.18 | 8.70 | 9.43 |
| 5.5 - 6.6 | 4.59 | 4.45 | 4.52 |
| 6.6 - 7.5 | 2.19 | 0.58 | 1.38 |
| 7.5 - 8.5 | 0.80 | 0.97 | 0.88 |
| 8.5 - 10.0 | --- | 0.37 | 0.20 |
| 10 - 12 | --- | --- | --- |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| 16 - 18 | --- | --- | --- |
| 18 - 20 | --- | --- | --- |
| | | | 99.99% |
| Number of Individual Particles Sized | 501 | 517 | 1018 |
| | Specification Size Range Distribution | | |
| < 0.75 | 5.19% | 3.29% | 4.22% |
| 0.75 - 5.5 | 87.23% | 90.32% | 88.79% |
| > 5.5 | 7.58% | 6.37% | 6.98% |

Table 25

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-486 - MLS #273

Duplicate Analysis of FP Collected on MF #1-56-29

from Aerosolization Test No. 166B

| Particle Size Range Micron Dia | 1st Analysis (CI) % | 2nd Analysis (MPP) % | Combined % |
|---|---|---|---|
| < 0.75 | 1.25 | 1.55 | 1.39 |
| 0.75 - 1.5 | 10.00 | 13.18 | 11.52 |
| 1.5 - 2.6 | 31.07 | 27.91 | 29.55 |
| 2.6 - 3.5 | 30.71 | 26.74 | 28.81 |
| 3.5 - 4.5 | 14.11 | 15.89 | 14.96 |
| 4.5 - 5.5 | 7.50 | 8.92 | 8.18 |
| 5.5 - 6.6 | 3.39 | 3.88 | 3.62 |
| 6.6 - 7.5 | 0.89 | 1.16 | 1.02 |
| 7.5 - 8.5 | 0.89 | 0.77 | 0.84 |
| 8.5 - 10.0 | 0.18 | --- | 0.09 |
| 10 - 12 | --- | --- | --- |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| 16 - 18 | --- | --- | --- |
| 18 - 20 | --- | --- | --- |
| | | | 99.98% |
| Number of Individual Particles Sized | 560 | 516 | 1076 |

Specification Size Range Distribution

| | | | |
|---|---|---|---|
| < 0.75 | 1.25% | 1.55% | 1.39% |
| 0.75 - 5.5 | 93.39% | 92.64% | 93.02% |
| > 5.5 | 5.36% | 5.31% | 5.57% |

METRONICS

Table 26

SUMMARY OF FP TRACER MATERIAL QUALITY CONTROL ANALYSES

FP 2267 - USRC Lot 487 MLS #274

| | | | |
|---|---|---|---|
| **Material Analyzed:** | | | |
| Type | | 2267 | |
| Fluorescent Color | | Yellow | |
| USRC Lot No. | | H-487 | |
| Metronics Lot Specimen No. | | #274 | |
| Date Received for Analysis | | 28 January 1965 | |
| **Aerosolization Analysis:** | | | |
| Test Nos. | | 167A & 167B | |
| Mass Mean Diameter (MMD) | | 3.17 microns | |
| Particles Per Gram (PPG) | | $1.51 \times 10^{10}$ | |
| **Particle Size Analysis:** | | | |
| IK-MF No. | 167A-1-76 | 167B-1-78 | Average |
| Specification Size Ranges: | | | |
| < 3/4 microns | 5.19% | 2.23% | 3.77% |
| 3/4 - 5.5 microns | 87.02% | 90.22% | 88.56% |
| > 5.5 microns | 7.79% | 7.55% | 7.67% |
| Number of Particles Sized | 1117 | 1033 | 2150 |
| **FP Quality Analysis:** | | | |
| IK-MF No. | A-1-76-27 | B-1-78-17 | Average |
| Off-Color Particles | 3.38% | 3.05% | 3.21% |
| Non-Fluorescent Particles | 5.81% | 4.70% | 5.25% |
| Number Particles Examined for Color and Fluorescence | 1154 | 1149 | 2108 |
| Bulk Powder Fluidity | | | OK |

Table 27

PARTICLES-PER-GRAM ANALYSIS OF FP MATERIAL FOR AIR TRACER STUDY

METRONICS LOT SPECIMEN NO. 274

Analysis made for: U.S. Public Health Service, pursuant to Purchase Order #11420, 25 June 1964.

Material tested: FP 2267-Yellow, USRC Lot #H-487. Tests performed on 1-lb specimen received 28 January 1965 via USRC Shipping Memorandum No. NJ-W 521.

| Aerosolization Test No. | Isokinetic Sampler No. | Aerosolization Factor Particles Per Gram |
|---|---|---|
| 167A | 1-76-27 | $1.641 \times 10^{10}$ |
| | 2-65-09 | 1.479 |
| | 3-54-20 | 1.474 |
| | 4-75-31 | 1.397 |
| | Test 167A Average | $1.498 \times 10^{10}$ |
| 167B | 1-78-17 | $1.655 \times 10^{10}$ |
| | 2-80-08 | 1.641 |
| | 3-72-06 | 1.286 |
| | 4-81-03 | 1.472 |
| | Test 167B Average | $1.514 \times 10^{10}$ |

Analysis Summary - Combined Data Tests 167A & 167B

| | |
|---|---|
| Aerosolization PPG - Mean Value | $1.51 \times 10^{10}$ |
| Aerosolization PPG - Coefficient of Variation | $\pm$ 8.19% |
| Equivalent Mass Mean Particle Diameter | 3.17 microns |

Table 28

SUMMARY OF FP TRACER PARTICLE SIZE DISTRIBUTION ANALYSES

Material: FP 2267 - USRC Lot H-487 - MLS #274

Aerosolization Test Results (167A & 167B): PPG $1.51 \times 10^{10}$; MMD 3.17μ

| Particle Size Range Micron Dia | Combined Analysis FP's Collected on MF from Test 167A % | Combined Analysis FP's Collected on MF from Test 167B % | Combined Analysis Both MF's % |
|---|---|---|---|
| < 0.75 | 5.19 | 2.23 | 3.77 |
| 0.75 - 1.5 | 14.50 | 10.16 | 12.42 |
| 1.5 - 2.6 | 24.17 | 29.82 | 26.88 |
| 2.6 - 3.5 | 22.92 | 24.98 | 23.91 |
| 3.5 - 4.5 | 16.65 | 16.46 | 16.56 |
| 4.5 - 5.5 | 8.77 | 8.81 | 8.79 |
| 5.5 - 6.6 | 4.66 | 4.84 | 4.84 |
| 6.6 - 7.5 | 1.52 | 1.65 | 1.58 |
| 7.5 - 8.5 | 1.16 | 0.68 | 0.93 |
| 8.5 - 10.0 | 0.45 | 0.29 | 0.37 |
| 10 - 12 | --- | --- | --- |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | 0.10 | 0.05 |
| | | | 100.00% |
| Number of Individual Particles Sized | 1117 | 1033 | 2150 |

Specification Size Range Distribution

| | | | |
|---|---|---|---|
| < 0.75 | 5.19% | 2.23% | 3.77% |
| 0.75 - 5.5 | 87.02% | 90.22% | 88.56% |
| > 5.5 | 7.79% | 7.55% | 7.67% |

Table 29

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot H-487 - MLS #274

Duplicate Analysis of FP's Collected on MF #1-76-27

from Aerosolization Test 167A

| Particle Size Range Micron Dia | 1st Analysis (MPP) % | 2nd Analysis (TSB) % | Combined % |
|---|---|---|---|
| < 0.75 | 5.89 | 4.61 | 5.19 |
| 0.75 - 1.5 | 13.16 | 15.62 | 14.50 |
| 1.5 - 2.6 | 26.33 | 22.37 | 24.17 |
| 2.6 - 3.5 | 22.01 | 23.68 | 22.92 |
| 3.5 - 4.5 | 14.15 | 18.75 | 16.65 |
| 4.5 - 5.5 | 9.04 | 8.55 | 8.77 |
| 5.5 - 6.6 | 5.89 | 3.62 | 4.66 |
| 6.6 - 7.5 | 1.18 | 1.81 | 1.52 |
| 7.5 - 8.5 | 1.96 | 0.49 | 1.16 |
| 8.5 - 10.0 | 0.39 | 0.49 | 0.45 |
| 10 - 12 | --- | --- | --- |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | --- | --- |
| | | | 99.99% |
| Number of Individual Particles Sized | 509 | 608 | 1117 |
| | Specification Size Range Distribution | | |
| < 0.75 | 5.89% | 4.61% | 5.19% |
| 0.75 - 5.5 | 84.68% | 88.97% | 87.01% |
| > 5.5 | 9.43% | 6.41% | 7.79% |

Table 30

PARTICLE SIZE DISTRIBUTION ANALYSIS: FP 2267 - USRC Lot #H-487 - MLS #274

Duplicate Analysis of FP's Collected on MF #1-78-17

from Aerosolization Test 167B

| Particle Size Range Micron Dia | 1st Analysis (MPP) % | 2nd Analysis (CI) % | Combined % |
|---|---|---|---|
| < 0.75 | 1.60 | 2.82 | 2.23 |
| 0.75 - 1.5 | 11.58 | 8.83 | 10.16 |
| 1.5 - 2.6 | 33.53 | 26.32 | 29.82 |
| 2.6 - 3.5 | 22.75 | 27.07 | 24.98 |
| 3.5 - 4.5 | 16.17 | 16.73 | 16.46 |
| 4.5 - 5.5 | 7.98 | 9.59 | 8.81 |
| 5.5 - 6.6 | 4.39 | 5.26 | 4.84 |
| 6.6 - 7.5 | 1.60 | 1.69 | 1.65 |
| 7.5 - 8.5 | 0.20 | 1.13 | 0.68 |
| 8.5 - 10.0 | 0.20 | 0.38 | 0.29 |
| 10 - 12 | --- | --- | --- |
| 12 - 14 | --- | --- | --- |
| 14 - 16 | --- | 0.19 | 0.10 |
| | | | 100.02% |
| Number of Individual Particles Sized | 501 | 532 | 1033 |
| | Specification Size Range Distribution | | |
| < 0.75 | 1.60% | 2.82% | 2.23% |
| 0.75 - 5.5 | 92.01% | 88.54% | 90.23% |
| > 5.5 | 6.39% | 8.65% | 7.56% |

Table 31

Log of FP 2267 Tracerite Shipped
25 Feb 65 to U.S. Public Health Service
Order No. 11420

| Bottle No. | USRC Lot No. | Gross | Tare | Net |
|---|---|---|---|---|
| 1 | 454* | 1716.9 | 102.5 | 1614.4 |
| 2 | 454 | 1625.5 | 105.2 | 1520.3 |
| 3 | 454 | 1619.0 | 104.3 | 1514.7 |
| 4 | 454 | 1626.6 | 107.2 | 1519.4 |
| 5 | 454 | 1611.0 | 104.9 | 1506.1 |
| 6 | 454 | 1660.6 | 105.4 | 1555.2 |
| 7 | 454 | 1628.6 | 105.6 | 1523.0 |
| 8 | 454 | 1555.4 | 104,1 | 1451.3 |
| 9 | 454 | 1627.5 | 103.5 | 1524.0 |
| 10 | 454 | 1674.9 | 102.0 | 1572.9 |
| 11 | 454 | 1582.3 | 102.5 | 1479.8 |
| 12 | 454 | 1636.2 | 103.4 | 1532.8 |
| 13 | 454 | 1537.3 | 107.1 | 1430.2 |
| 14 | 454 | 1458.6 | 104.0 | 1354.6 |
| 15 | 454 | 1309.4 | 106.4 | 1203.0 |

Total FP this shipment 22301.7 grams (49.2 lbs)

Average Net Weight per 32 oz plastic bottle 1486.8 grams (3.31bs)

*Metronics Lot Specimen #275

Table 32

Log of FP 2267 Tracerite Shipped
July 65 to U.S. Public Health Service
Order No. 11420

| Bottle No. | MLS No. | Lot No. | Gross | Tare | Net |
|---|---|---|---|---|---|
| 16 | 295 | 483 | 1985.2 | 104.6 | 1880.6 |
| 17 | 295 | 483 | 1989.6 | 100.0 | 1889.6 |
| 18 | 295 | 483 | 1964.3 | 106.1 | 1858.2 |
| 19 | 295 | 483 | 1980.3 | 107.0 | 1873.3 |
| 20 | 295 | 483 | 1911.4 | 104.3 | 1807.1 |
| 21 | 295 | 483 | 1996.1 | 106.3 | 1889.8 |
| 22 | 295 | 483 | 1860.0 | 106.5 | 1753.5 |
| 23 | 295 | 483 | 1994.5 | 106.7 | 1887.8 |
| 24 | 295 | 483 | 1969.7 | 107.1 | 1862.6 |
| 25 | 295 | 483 | 1980.6 | 106.4 | 1874.2 |
| 26 | 295 | 483 | 1906.9 | 105.2 | 1801.7 |
| 27 | 295 | 483 | 1919.8 | 105.1 | 1814.7 |
| 28 | 296 | 483 | 1990.0 | 104.7 | 1885.3 |
| 29 | 296 | 483 | 1950.7 | 106.6 | 1844.1 |
| 30 | 296 | 483 | 1993.6 | 100.4 | 1893.2 |
| 31 | 296 | 483 | 1926.7 | 104.6 | 1822.1 |
| 32 | 296 | 483 | 1969.7 | 106.9 | 1862.8 |
| 33 | 296 | 483 | 1956.1 | 107.3 | 1848.8 |
| 34 | 296 | 483 | 1926.8 | 103.8 | 1823.0 |
| 35 | 296 | 483 | 1893.9 | 104.1 | 1789.8 |
| 36 | 296 | 483 | 1970.0 | 106.8 | 1863.2 |
| 37 | 296 | 483 | 1997.3 | 103.9 | 1893.4 |
| 38 | 296 | 483 | 1982.8 | 108.0 | 1874.8 |
| 39 | 296 | 483 | 1934.8 | 104.3 | 1830.5 |
| 40 | 299 | 484 | 1983.6 | 105.2 | 1878.4 |
| 41 | 299 | 484 | 1831.8 | 105.3 | 1826.5 |
| 42 | 299 | 484 | 1969.8 | 104.6 | 1865.2 |
| 43 | 299 | 484 | 1983.8 | 108.1 | 1875.7 |
| 44 | 299 | 484 | 1921.8 | 101.6 | 1820.2 |
| 45 | 299 | 484 | 1959.2 | 107.6 | 1851.6 |
| 46 | 299 | 484 | 2016.1 | 104.7 | 1911.4 |

Table 32 continued

| Bottle No. | MLS No. | Lot No. | Gross | Tare | Net |
|---|---|---|---|---|---|
| 47 | 299 | 484 | 1977.1 | 108.2 | 1868.9 |
| 48 | 299 | 484 | 2025.8 | 106.8 | 1919.0 |
| 49 | 299 | 484 | 2020.3 | 104.2 | 1916.1 |
| 50 | 299 | 484 | 1962.2 | 100.7 | 1861.5 |
| 51 | 299 | 484 | 1970.0 | 105.2 | 1864.8 |
| 52 | 300 | 484 | 1882.8 | 104.3 | 1778.5 |
| 53 | 300 | 484 | 1926.4 | 103.9 | 1822.5 |
| 54 | 300 | 484 | 1908.2 | 104.9 | 1803.3 |
| 55 | 300 | 484 | 1925.8 | 106.7 | 1819.1 |
| 56 | 300 | 484 | 2037.2 | 105.5 | 1931.7 |
| 57 | 300 | 484 | 1959.4 | 104.2 | 1855.2 |
| 58 | 300 | 484 | 2021.2 | 106.2 | 1915.0 |
| 59 | 300 | 484 | 2002.9 | 106.2 | 1896.7 |
| 60 | 300 | 484 | 2005.8 | 104.3 | 1901.5 |
| 61 | 300 | 484 | 2000.1 | 105.8 | 1894.3 |
| 62 | 300 | 484 | 1952.7 | 105.1 | 1847.6 |
| 63 | 300 | 484 | 2010.8 | 105.3 | 1905.5 |
| 64 | 301 | 485 | 1973.7 | 106.6 | 1867.1 |
| 65 | 301 | 485 | 2005.7 | 107.1 | 1898.6 |
| 66 | 301 | 485 | 1898.1 | 106.1 | 1792.0 |
| 67 | 301 | 485 | 1963.6 | 107.4 | 1856.2 |
| 68 | 301 | 485 | 2031.6 | 104.8 | 1926.8 |
| 69 | 301 | 485 | 1958.4 | 107.8 | 1850.6 |
| 70 | 301 | 485 | 1980.9 | 107.3 | 1873.6 |
| 71 | 301 | 485 | 1988.3 | 107.8 | 1880.5 |
| 72 | 301 | 485 | 2000.2 | 104.9 | 1895.3 |
| 73 | 301 | 485 | 1968.1 | 107.5 | 1860.6 |
| 74 | 301 | 485 | 1988.7 | 107.7 | 1881.0 |
| 75 | 301 | 485 | 1965.3 | 107.2 | 1858.1 |
| 76 | 302 | 485 | 1970.0 | 106.0 | 1864.0 |
| 77 | 302 | 485 | 1950.2 | 107.3 | 1842.9 |
| 78 | 302 | 485 | 1964.1 | 109.9 | 1854.2 |
| 79 | 302 | 485 | 2000.0 | 106.9 | 1893.1 |
| 80 | 302 | 485 | 1987.1 | 106.7 | 1880.4 |

Table 32 continued

| Bottle No. | MLS No. | Lot No. | Gross | Tare | Net |
|---|---|---|---|---|---|
| 81 | 302 | 485 | 1974.1 | 100.6 | 1873.5 |
| 82 | 302 | 485 | 1992.9 | 105.3 | 1887.6 |
| 83 | 302 | 485 | 1997.2 | 106.8 | 1890.4 |
| 84 | 302 | 485 | 2008.2 | 106.1 | 1902.1 |
| 85 | 302 | 485 | 1987.7 | 105.4 | 1882.3 |
| 86 | 302 | 485 | 1930.0 | 108.4 | 1821.6 |
| 87 | 302 | 485 | 1950.0 | 105.8 | 1844.2 |
| 88 | 303 | 486 | 2024.3 | 107.2 | 1917.1 |
| 89 | 303 | 486 | 2023.5 | 106.1 | 1917.4 |
| 90 | 303 | 486 | 1908.2 | 107.7 | 1800.5 |
| 91 | 303 | 486 | 1908.6 | 107.5 | 1801.1 |
| 92 | 303 | 486 | 1998.9 | 106.7 | 1892.2 |
| 93 | 303 | 486 | 1992.9 | 105.2 | 1887.7 |
| 94 | 303 | 486 | 2006.3 | 108.1 | 1898.2 |
| 95 | 303 | 486 | 2005.8 | 100.7 | 1905.1 |
| 96 | 303 | 486 | 1960.8 | 107.8 | 1853.0 |
| 97 | 303 | 486 | 2006.7 | 106.4 | 1900.3 |
| 98 | 303 | 486 | 1897.8 | 105.1 | 1792.7 |
| 99 | 303 | 486 | 1954.9 | 107.0 | 1847.9 |
| 100 | 304 | 487 | 1953.2 | 108.9 | 1844.3 |
| 101 | 304 | 487 | 2015.1 | 106.1 | 1909.0 |
| 102 | 304 | 487 | 1897.6 | 108.4 | 1789.2 |
| 103 | 304 | 487 | 2061.1 | 107.9 | 1953.2 |
| 104 | 304 | 487 | 1965.2 | 104.5 | 1860.7 |
| 105 | 304 | 487 | 2015.9 | 106.7 | 1909.2 |
| 106 | 304 | 487 | 1999.4 | 106.3 | 1893.1 |
| 107 | 304 | 487 | 1983.9 | 105.7 | 1878.2 |
| 108 | 304 | 487 | 1973.2 | 105.5 | 1867.7 |
| 109 | 304 | 487 | 1929.6 | 106.2 | 1823.4 |
| 110 | 304 | 487 | 1946.4 | 106.8 | 1839.6 |
| 111 | 304 | 487 | 1984.3 | 107.8 | 1876.5 |
| 112 | 304 | 487 | 2011.2 | 105.4 | 1905.8 |
| 113 | 304 | 487 | 2014.8 | 108.1 | 1906.7 |
| 114 | 304 | 487 | 1921.3 | 108.9 | 1812.4 |
| 115 | 305 | 487 | 1930.7 | 107.6 | 1823.1 |

Table 32 Continued

| Bottle No. | MLS No. | Lot No. | Gross | Tare | Net |
|---|---|---|---|---|---|
| 116 | 305 | 487 | 1933.1 | 105.3 | 1827.8 |
| 117 | 305 | 487 | 1953.3 | 103.4 | 1849.9 |
| 118 | 305 | 487 | 1918.3 | 105.4 | 1812.9 |
| 119 | 305 | 487 | 1984.8 | 107.5 | 1877.3 |
| 120 | 305 | 487 | 1976.7 | 103.7 | 1873.0 |
| 121 | 305 | 487 | 2060.0 | 105.2 | 1954.8 |
| 122 | 305 | 487 | 1998.8 | 105.2 | 1893.6 |
| 123 | 305 | 487 | 1989.6 | 103.9 | 1885.7 |

Total FP this shipment 444.0 lbs.

Average Net Weight per 32 oz plastic bottle 1859.8 grams (4.1 lbs).

METRONICS

*Product Bulletin No. 12-65*

**FP TRACER EQUIPMENT**

## AEROSOL GENERATOR, Model 5

Complete system including Model 8 Aerosol Generator Control Unit. Also included, but not shown in photos, is a transit and storage case with compartments for protective stowage of feed mechanism, blower and stand assemblies together with essential power cabling and accessories. Storage space also available for spare feed mechanisms and pre-filled and weighed bottles of fluidized FP tracer. As shown in upper photo, feed mechanism is provided with special fittings for recharging hopper with fluidized FP tracer while unit is running. Using plastic squeeze bottle as shown, 1800 grams of fluidized FP may be transferred into the hopper within a minute or two.



METRONICS ASSOCIATES, INC. 3201 PORTER DRIVE · STANFORD INDUSTRIAL PARK · PALO ALTO, CALIFORNIA